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Test of the argument for remote dynamic triggering by small mainshocks
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To understand earthquake interaction and forecast time-dependent seismic hazard, it is essential to determine whether static or dynamic stress change triggers most aftershocks and subsequent mainshocks. Felzer and Brodsky (2006) argued that the observed linear seismic density of small aftershocks with distance from small mainshocks is a product of the decay of seismic wave amplitude. They conclude that even small shocks can dynamically trigger remote earthquakes at distances more than ten source fault dimensions away. Richards-Dinger et al. (2010) counter-argue that the power law decay is an apparent product from independent aftershocks occurring along a large rupture zone or near-simultaneous occurrence in seismic swarms. To test the argument of Richards-Dinger et al. (2010), we use the Taiwanese earthquake catalog of the Central Weather Bureau Seismic Network, whose quality is as good as that in California and Japan. Further, we take an advantage of the absence of major inland earthquakes and significant swarms in the period, 2001-2011.

We follow the methodology of Felzer and Brodsky (2006) for selecting mainshocks using their declustering algorithm, and then seek all shocks that occurred within 5 minutes to make a diagram of linear aftershock density as a function of distance from mainshock. First we select as a mainshock any event that is not preceded by a larger shock within 3 days (t1) and 100 km, and that is not followed by a large shock within 12 hr (t2) and 100 km. The mainshocks and aftershocks are 2?M<3 and M?2 respectively. This yields 706 declustered mainshocks from the 110,157 candidate shocks, but the number of mainshock-aftershock pairs is just 56. We only find four pairs within 50 km distance range (the maximum considered by Felzer and Brodsky), which precludes any regression, while the others located further than 50 km are regarded as background. We then shorten the time period for both t1 and t2 to be 1.5 days and 0.25 days, which allows us to regress a power law slope of -1.16 ± 0.45 for the 35 pairs within the 50-km distance range. The pairs are located mostly along the northern part of the Longitudinal Valley fault zone where small swarm activity and M~6 shocks often occur. We conclude that the much fewer ratios of mainshock-aftershock pairs in the Taiwanese catalog, in comparison to California and Japan, are due to lack of any large rupture and the absence of significant swarms in Taiwan, which supports the argument of Richards-Dingers et al. and renders the possibility that these small shocks are dynamically triggered untenable.